



Docket No.: NIH-0127
 Inventor: Mario H. Skiadopoulos et al.
 Title: ATTENUATED HUMAN-BOVINE
 CHIMERIC PARAINFLUENZA VIRUS (PIV)
 VACCINES Page 1 of 27
 Serial No.: 09/900,112 Filing Date: July 5, 2001

09/900,112 201502

SEQ ID NO: 35

ACCAAACAAG AGAAGAGACT TGCTTGGGAA TATTAAT TCA AATAAAAAATT AACCTT AGGAT 60
 TAAAGAACCTT TACCGAAAGG TAAGGGGAAA GAAATCC TAA GACTGTAATC ATGTT GAGTC 120
 TATTTCGACAC ATTCAGTGCG CGTAGGCAGG AGAACATAAC GAAATCAGCT GGTGG GCGTC 180
 TTATTCGCCG GCAAAAAAAC ACTGTGTCTA TATTTCGTCT TGGACCATCA ATAACAGATG 240
 ACAATGATAA AATGACATTG GCTCTCTCT TTTGTCTCA TCTTTAGAC AATGAAAAGC 300
 AGCATGCGCA AAGAGCTGGA TTTTAGTATT CTCTGTTATC AATGGCTTAT GCCAA CCCAG 360
 AATTATATTT AACATCAAAAT GGTAGTAATG CAGATGT TAA ATATGTTATC TACAT GATAG 420
 AGAAAGACCC AGGAA GACAG AAATATGGTG GGT TTGTCGT CAAGACTAGA GAGATGGTTT 480
 ATGAAAGAC AACTGATTGG ATGTTCCGGA GTGATCT TGA GTATGATCAA GACAA TATGT 540
 TGCAAAATGG TAGAAGCACT TCTACAATCG AGGATCT TGT TCATACCTTT GGTATA TCCAT 600
 CGTGTCTTGG AGCCCTTATA ATCCAAGTTT GGATAA TACT TGTAAAGCT ATAA CCAGTA 660
 TATCAGGATT GAGGAAAGGA TTCTTTACTC GGTAGAAGC ATTTGACAA GATGG AACAG 720
 TTAATCCAG TCTAGTGTG AGCGGTGATG CAGTAGAACA AATTGGATCA ATTAT GAGGT 780
 CCCAAAGAG CTTGGTAACA CTCATGGTTG AAACATGAT AACAAATGAAC ACAGG CAGGA 840
 ATGATCTGAC AACAAATGAA AAGAATATAC AGATTGTAGG AAACATC ATC AGAGATG CAG 900
 GTCTTGTCTC ATTTTCAAC ACAATCAGAT ATGGCAT TGA GACTAGAATG GCAGC TCTAA 960
 CTCTGTCTAC CCTTAGACCG GATATCAACA GACTCAA GGC ACTGATCGAG TTATA TCTAT 1020
 CAAAGGGGCC ACGTGCTCCT TTTATATGCA TTTGAGAGA TCCCGTGAT GGTGA GTTTG 1080
 CACCAGGCAA CTATCTGCC CTCTGGAGTT ATGCGATGG TGTAGCAGTT GTACAA AACA 1140
 AGGCCATGCA ACAGTATGTA ACAGGAAGGT CTTATCT GGA TATTGAAATG TTCCA ACTTG 1200
 GTCAAGCAGT GGCACGTGAT GCCAGTGC AGATGAG TTC AATATTAGAG GATGA ACTGG 1260
 GGGTCAACA AGAAGCCAG CAAAGCTTGA AGAACAATC GAAGAATC AGCAGT TCAG 1320
 ATACAACCTT TCATAAGCCT ACAGGGGGAT CAGCCAT AGA AATGGCGATA GATGA AGAAG 1380
 CAGGGCAGCC TGAATCCAGA GGAGATCAGG ATCAAGGAGA TGAGCCTCGG TCATC CATAG 1440
 TTCCTTATGC ATGGGCAGAC GAAACCGGGA ATGACAA TCA AACTGAATCA ACTAC AGAAA 1500
 TTGACAGCAT CAAAAC TGAA CAAAGAAACA TCAGAGACAG GCTGA ACAAA AGACTCAACG 1560
 AGAAAAGGAA ACAGAGTGAC CCGAGATCAA CTGACAT CAC AAACAACACA ATCA AACTG 1620
 AAAATAGTGA TTTGTTGAT GCATTGCGAA GCAACTAGTC ACAAAGAGAT GACCA CTATC 1680
 ACCAGCAACA AGTAAGAAA ACTTAGGATT AATGGAAATT ATCCAATCCA GAGACGGAAG 1740
 GACAAATCCA GAATCCAAC ACAACTCAAT CAACCAAAGA TTCATGGAAG ACAAT GTTCA 1800
 AAACAATCAA ATCATGGATT CTTGGGAAGA GGGATCA GGA GATAAATCAT CTGAC ATCTC 1860
 ATCGGCCCTC GACATCATTG AATTCATACT CAGCACC GAC TCCCAAGAAA ACACGGCAGA 1920
 CAGCAATGAA ATCAACACAG GAACCAAG ACTTAGCAG ACAATCTACC AACCTGAATC 1980
 CAAAACAACA GAAACAAGA AGGAAAATAG TGGACCA GCT AACAAAAATC GACAG TTTGG 2040
 GGCATCACAC GAACGTGCCA CAGAGACAAA AGATAGAAAT GTTAATCAGG AGACT GTACA 2100
 AATCTCCAGA AGCAGCCAG ATCCTAACAA TGGAAACC CAA ATCCAGGAAG ATATT GATTA 2220
 CAATGAAGTT GGAGAGATGG ATAAGGACTC TACTAAGAGG GAAATGCGAC AATTTAAAGA 2280
 TGTCCAGTC AAGGTATCAG GAAGTGATGC CATTCTCCA ACAAACAAG ATGGA GACGG 2340
 TGATGATGGA 2350

FIGURE 1A



SEQ ID NO: 35

AGAGGCGCTGG AATCTATCAG TACATTTGAT TCAGGATATA CCGATATAGT GACTGCCGCA 2410
ACACTAGATG AGAAGAAGA ACTCCTTATG AAGAACAACA GGGCAAGAAA GTATCAATCA 2470
ACACCCAGAG ACAGTGACAA GGAATTAA AAAGGGGTTG GAAGGCCAAA AGACAAGAC 2530
AAACAATCAT CAATATTGGA CTACGAAGCTC AACTTCAAGG GATCGAAGAA GAGCCAGAAA 2590
ATCCTCAAG CCAGCAGCAA TACAGGAGAA CCAACAA GAC CACAGAATGG ATCCAGGGG 2650
AAGAGAATCA CATCCTGGA CATCCTCAAC AGCGAGA GCG GCAATCGAAC AGAATCAACA 2710
AACCACACC ATCAGACATC AACCTCGGGA CAGAACCACA CAATGGGACC AAGCAGAACA 2770
ACCTCGAAC CAAGGATCAA GACACAAAAG ACGGATGGAA AGAAGAGAGA GGACACAGAA 2830
GAGAGCACT GATTACAGA AAGGCGGATT ACATTAT TAC AGAATCTGG TGTAACTCAA 2890
TCTGCAGCAA AATTAGACCT ATACCAAGAC AAGAGAGTTG TGTGTGTGGC GAATGTCCTA 2950
AACATGACG ATACTGCATC AAGATAGAC TTCTAGCAG GTTTGATGAT AGGAGTGTCA 3010
ATGGATCATG ATACCAAT TAAATCAGATT CAGAACGAGA TATTAAGTTT GAAAACTGAT 3070
CTTAAAAAGA TGGATGAATC ACATAGAAGA CTAATTGAGA ATCAAAAAGA ACAATATATCA 3130
CTGATCACAT CATTAATCTC AATCTTAA ATTATGACAG AGAGAGGAGG GAAGAAGGAC 3190
CAACCGAAGC CTAGCGGGAG GACATCCATG ATCAAGACAA AAGCAAGAAG AGAGAAAATA 3250
AAGAAAGTCA GGTTTGACCC TCTTATGGAA ACACAGG GCA TCGAAGAAAA CATCCCTGAC 3310
CTCTATAGAT CAATAGAGAA AACACAGAA AACGACA CAC AGATCAAAATC AGAAA TAAAC 3370
AGATTGAATG ATGAATCCAA TGCCACTAGA TTAGTACCTA GAAGAATAAG CAGTACAATG 3430
AGATCATTAA TAATAATCA TTAACAACAGC AATTTATCAT CAAAAGCAAA GCAATCATAC 3490
ATCAACGAAC TCAAGCTCTG CAAGAGTGAC GAGGAAGTGT CTGAGTTGAT GGACATGTTC 3550
AATGAGGATG TCAGCTCCCA GTAAACCGCC AACCAAGGGT CAACACCAAG AAAACCAATA 3610
GCACAAAACA GCCAATCAGA GACCACCCCA ATACACCAAA CCAATCAACA CATACAAGAG 3670
ATCTCCAGAT CATAGATGAT TAAGAAAAAC TTAGGATGAA AGGACTAATC AATCCCTCCGA 3730
AACATGAGC ATACCAACT CCACAATCTA CACATTCOCA GAATCCTCTT TCTCCGAGAA 3790
TGGCAACATA GAGCCGTTAC CACTCAAGGT CAATGAA CAG AGAAAGGCCA TACTCATAT 3850
TAGGGTTGTC AAGATAGGAG ATCCGCCCAA ACATGGATCC AGATATCTGG ATGCTTTTT 3910
ACTGGGCTTC TTGAGATGG AAAGGTCAA AGACAGG TAT GGGAGCATA GTGATCTAGA 3970
TGATGATCCA AGTTACAAGG TTTGTGGCTC TGATCA TTG CCACTGGGT TGGCTAGATA 4030
CACCGAAAT GATCAGGAAC TCCTACAGGC TGCAACCAAG CTCGATATAG AAGTAAGAG 4090
AACTGTAAG GCTACGGAGA TGATAGTTTA CACTGTACAA AACATCAAC CTGAACATA 4150
TCCATGTGCC ATAGATTAA GAAAGGGAT GTTATT GAC GCTAATAAGG TTGCACTTGC 4210
TCCTCAATGT CTTCCACTAG ATAGAGGGAT AAAATTCAGG GTGATATTG TGAATGAC 4270
AGCAATTGGA TCAATAACTC TATTCAAAAT CCTAAGTCC ATGGCATTTG TATCATTCGC 4330
TAATACAATA CAATAAATC TACAAGTACA TATCAAAACA GGAGTTCAGA CAGATTCCAA 4390
AGGAGTAGTT CAGATTCTAG ATGAAAAAGG TGAAAAATCA CTAATTTTCA TGGTTTATCT 4450
CGGGTTGATC AAAAGGAAGA TGGGCAAGAT GTACTCAGTT GAATATTGTA AGCAGAAGAT 4510
CGAGAAGATG AGATTATTA TCTCATTGGG ATTAGTTGGA GGGATCAGCT TCCAGTCAA 4570
CGCAACTGGC TCTATATCAA AGACATTAGC AAGTCAATTA GCATTCAAAA GAGAAATCTG 4630
CTATCCCTTA ATGGATCTGA ATCCACACTT AAATCA GTT ATATGGGCAT CATCAATTGA 4690
AATTACAAGG 4700

FIGURE 1B



224000112 101502

SEQ ID NO: 35

GTAGATGCAG TTCTCCAGCC TTCATTACCT GCGGAAT TCA GATACTACCC AAACA TCATA 4760
GCAAAAGGGG TCGGGAATAA CAGACAGTAA AATCAACAAC CCTGATATCC AACAT TGCAA 4820
ATCAGGCTAC CCACAGGAGA AAAATCAAAA ACTTAGGATC AAAGGGATCA CCACG AACCC 4880
CGGAAACACG CCAACACAAAC CACACACAAA ATCAGACAGA AAAAGGAGAA GGCAC TGCAA 4940
AGACCGAGAA AAAACAGAAC GCACACAACC AAGCAGAGAA AAGCCAAAGC CGGCCATTCA 5000
CAACACACACC AACATCTCTG CAACACAGCA CCAAAACAGA GGTCAAAAGA CAAGAGACAC 5060
CAGATATGAC CATCAACAAC ACAATCATAG CCATATTACT AATACCCCA TCATT TTGTC 5120
AAATAGACAT AACAAAACCTG CAACGTGTAG GTGTGTAGT CAACAATCCT AAAGGCATGA 5180
AGATTTCACA AAATTCGAA ACGAGATACC TGATATT AAG TTTGATACCC AAAAT AGAGA 5240
ATTACACACT ATGTGGGGAT CAACAGATAA ACCAATACAA GAAGTTATTG GATAGATTGA 5300
TAATTCCTCT ATATGATGGA TTAATAATTAC AAAAAGA TGT AATAGTAGTA AGTCATGAAA 5360
CCCAACAA TACTAATCTT AGGACAAAAC GATTCTT TGG AGAGATAATT GGCAC AATTG 5420
CGATAGGGAT AGCCACTTCA GCACAAATCA CGGCAGCAGT CGCTCTTGTG GAAGC TAAAC 5480
AGGCAAAATC AGACATAGAA AAACCTCAAG AGGCTAT AAG AGACACAAC AAGGCAGTAC 5540
AATCGATTCA AAGTCTGTGA GGTAACCTAA TTGTTGAGT TAAATCAGT T CAAGCATATG 5600
TCAACATGA AATTATACCT TCAATCACAA GATTAGGCTG TGAAGCAGCA GGGTACAAT 5660
TGGGAATTGC ATTGACACAA CATTACTCAG AATTAACAAA TATATTGGT GATAA TATAG 5720
GAACATGAA AGAAAAAGG ATAAAAATTAC AAGGGATAGC ATCATTATAT CACACAAAAC 5780
TAACGGAAAT ATTTACTACT TCAACAGTTG ACCAATA TGA TATTTATGAC TATTTATTCA 5840
CTGAGTCAAT CAAGATGAGA GTGATAGATG TTGATTT GAG TGATTACTCA ATTAC TCTTC 5900
AAGTTAGACT TCTTTATTA ACTAACTAT CAAATACTCA AATTATATA GTAGA TTCTA 5960
TATCATACAA CATCCAGGGC AAAGAGTGGT ATATTCTCTT TCCCAATCAC ATCATGACAA 6020
AAGGGGCTTT TCTAGTGGT GCTGATATTA AAGAATGCAT AGAGGCATTG AGCAG TTATA 6080
TATGTCCTTC TGATCCAGGT TACATATTTAA ATCAGAGAT AGAGAATTGT TTATCAGGGA 6140
ACATAACACA GTGTCCTAAG ACTGTTGTTA CATCAGATGT GGTACCAGCA TACGC GTTTG 6200
TGAATGGTGG ATTAATTGCA AACTGCATAA CAACATACAT TACATGCAAT GGAAT TGACA 6260
ATAGAATTAA TCAATCACTT GATCAAGGAA TTAAGAT CAT AACACATAAA GAATG CCAGG 6320
TAATAGGTAT AAACGGAATG TTATTCAATA CTAATAGAGA AGGACATTAA GCAAC TTATA 6380
CATTGTATGA CATCATATTA AATAACTCTG TTGCACTTAA TCCAA TTGAT ATATCTATGG 6440
AACTCAACAA GGCAAAACTA GAATTAGAAG AATCGAAGGA ATGGATAAAG AAATCAAACT 6500
AAAAGTTAGA TTCGTTGGA AGTTGGTATC AATCTAG TGC AACATCACCC ATATAT CATG 6560
TGATGATAAT AATTCTAGTT ATAATCAATA TAACAAT TAT TGTAGTCATA ATCAA ATTCC 6620
ATAGAATTCA GGGGAAAGAT CAAAACGACA AAAACAG TGA GCGGTATATA CTGACAAATA 6680
GACAATAAGA CTATACACGA TCAATATATA AAAGTACAAA AAACCTAGGA ACAAA GTTGT 6740
TCAACACAGC AGCACCGAAT AGACCAAAAG GCAGCGCAGA GCGACACCA AACTCAAAAA 6800
TGGAATATTG GAAACACACA AACAGCATAA ATAAACCAA CAATGAAACC GAAACAGCCA 6860
GAGGCAACA TAGTAGCAAG GTTACAATA TCATAATGTA CACCTTCTGG ACAAT AACAT 6920
TAAACAATT ATCAGTCAT TTTATAATGA TATTGACAAA CTTAATTCAA GAGAA CAATC 6980
ATAATAAAT ATGTTGCGAG GAAATAAGAA AAGAATT CGC GGCAATAGAC ACCAA GATTG 7040
AGAGGACTTC 7050

FIGURE 1C



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SEQ ID NO: 35

GGATGACATT GGAACCTCAA TACAGTCAGG AATAAATACA AGACTTCTCA CAATT CAGAG 7110
TCATGTTCAA AACTATATCC CACTATCATT AACACAACAA ATGTCAGATC TCAGAAAAAT 7170
TATCAATGAT TTAACAAATA AAGAGAGAACA TCAAGAAATG CCAATACAGA GAATGACTCA 7230
TGATAGAGGT ATAGAACCCC TAAATCCAAA CAAGTTCTGG AGGTGTACAT CTGGTAACCC 7290
ATCTCTAACA AGTAGTCCTA AGATAAGGTT AATACCAGGA CCAGGTTTAT TAGCAACATC 7350
TACTACAGTA AATGGCTGTA TTGAATTCC ATCGTTAGTA ATCAATCATC TAATCTATGC 7410
TTACACCTCT AATCTTATTA CCCAGGGCTG TCAAGATATA GGGAAATCTT AACCAAGTACT 7470
ACAAATAGGG ATAATTACTA TAAATTCGGA CCTAGTACCT GATTTAAACC CCAGAGTCAC 7530
ACATACATTT AATATTGATG ATAATAGAAAG ATCTTGCCTCT CTGGCACTAT TGAATACAGA 7590
TGTTTATCAG TTATGCTCAA CACCAAAAGT TGATGAAAGA TCGATTATG CATCAACAGG 7650
TATTGAGGAT ATTGTACTTG ACATTGTCCAC TAATAATGGA TTAATTATAA CAACAAGGTT 7710
TACAAATAAT AATAATAACTT TTGATAAACC GTATGCAGCA TTGATCCAT CAGTGGGACC 7770
AGGAATCTAT TATAAGGATA AAGTTATATT TCTCGGATAT GGAGGTCAG AGCATGAAGA 7830
AAACGGAGAC GTAATATGTA ATACAACCTGG TTGTCTGGC AAAACACAGA GAGACTGTAA 7890
TCAGGCTTCT TATAGCCCAT GGTTCCTCAA TAGGAGAATG GTAACTCTA TTATTGTGTG 7950
TGATAAAGGC ATAGATGCAA CTTTAGCTT GAGGGTGTGG ACTATTCCAA TGAGCCAAAA 8010
TTATTGGGGA TCAGAAAGGAA GATTACTTTT ATTAGGTGAC AGAATATACA TATATACTAG 8070
ATCCACAAGT TGGCAGCAGTA AATTACAGTT AGGGGTAAAT GATATTCTG CATATACTAA 8130
TATAAGAATA AATTGGACTT GGCATAATGT ACTATCAGG CCAGGGAATG ATGAAATGTC 8190
ATGGGGTCAT TCATGCCAG ACGGATGTAT AACAGGAGTT TACACTGATG CATATCCGCT 8250
AAACCCATCG GGGAGTGTG TATCATCAGT AATTCTT GAT TCACAAAAGT CTAGAGAAAA 8310
CCCAATCATT ACTTACTCAA CAGCTACAAA TAGAATAAAT GAATTAGCTA TATATAACAG 8370
AACACTTCCA GCTGCATATA CAACAACAAA TTGTATCACA CATTATGATA AAGGGTATTG 8430
TTTTCATATA GTAGAAATAA ATCAGAGAGG TTTGAATACG TTTCACCTA TGTTATTCAA 8490
AACAGAAGTT CCAAAAAACT GCAGCTAAAT TGATCATCG ATATCGGATG CAAGATGACA 8550
TTAAAGAGCA CACACAGACA GACAACACAG GAGACGATG AAGATATAAA GAAATATAA 8610
AAAACCTAGG AGAAAAAGTG GCAAGAAAAA TGGACACGGA GTCCCAACAGC GGCACAACT 8670
CTGACATTCT GTACCCCTGAA TGTCACCTCA ATTCTCTAT AGTTAAAGGA AAGATAGCAC 8730
AACTGCATAC AATAATGAGT TTGCCTCAGC CCTACGATAT GGATGATGAT TCAATACTGA 8790
TTATTACTAG CCAAAAAAAT AAACCTAATA AATTAGATAA AAGACAACGG TCAATTAGGA 8850
AATTAAGATC AGTCTTAATG GAAAGAGTAA GTGATCTAGG TAAATATACC TTTATCAGAT 8910
ATCCAGAGAT GTCTAGTGAA ATGTTCCAAT TATGTATACC CGGAATTAAT AATAAAAAA 8970
ATGAATTGCT AAGTAAAGCA AGTAAACAT ATAATCAAT GACTGATGGA TTAAGAGATC 9030
TATGGGTAC TATATATCG AAGTTAGCAT CGAAAAATGA TGGAAAGTAA TCAATATACA 9090
ATGAAGATAT TAGCAATATA TCAAAATGTT ACATGACTTA TCAATCAGAC AAATGGTATA 9150
ATCCATTCAA GACATGGTTT ACTATTAAGT ATGACATGAG AAGATTACAA AAGCCAAAA 9210
ATGAGATTAC ATTCAATAGG CATAAAGATT ATAATCTATT AGAAGACCAA AAGATATAT 9270
GGTGATACA TCCAGAACTC GTCTTAATAT TAGATAAACA AAATTACAA TGGTATATAA 9330
TGACTCCTGA ATTGGTACTA ATGTATTGTG ATGTAGTTGA AGGGAGGTGG AATATAAGTT 9390
CATGTGCAAA 9400

FIGURE 1D



SEQUENCE LISTING

SEQ ID NO: 35

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ATTGGATCCT AAGTTACAAT CAATGTATTA TAAGGGTAAC AATTATTGGG AAATAATAGA 9460
TGGACTATTTC TCGACCTTAG GAGAAAGAAC ATTTGACATA ATATCACTAT TAGAACCACT 9520
TGCATTATG C TCATTCAA CTTATGACCC GGTAAACAG CTCAGGGGGG CTTTTTAA 9580
TCAGCTGTTA TCAGAAATGG AATTAAATTT TGCAGCTGAG TGTACAACAG AGGAAATACC 9640
TAATGTGGAT TATATAGATA AAATTTTAGA TGTGTTCAA GAATCAACAA TAGATGAAAT 9700
AGCAGAAAT TTCTCTTTCT TCCGAACCTT TGGACACCT CCATTAGAGG CGAGTATAGC 9760
AGCAGAGAAA GTTAGAAAGT ATATGTATAC TGAGAAATGC TTGAAATTTG ATACTATCAA 9820
TAAATGTGAT GCTATTTTTT GTACAATAAT TATAAATGGA TATAGAGAAA GACATGGTGG 9880
TCAATGGCCT CCAGTTACAT TACCTGTCCA TGCACATGAA TTTATCATAA ATGCAACGAG 9940
ATCAAATTTCT GCCATATCAT ATGAGAATGC TGTAGAT TAT TATAAGAGCT TCATAGGAAT 10000
AAAATTTGAC AAGTTTATAG AGCCTCAATT GGATGAAAGC TTAATATTTT ATATGAAAGA 10060
TAAAGCATTA TCCCCAAGA AATCAAAGTG GGACACATGC TATCCAGCTT CAAACCTGTT 10120
ATACCGCACT AATGTGTCTC ATGATTCACG AAGATTGTTG TAAGTATTTA TAGCAGATAG 10180
TAAATTTGAT CCCCACCAAG TATTAGATTA CGTAGAA TCA GGATATTGGC TGGATGATCC 10240
TGAATTTAAT ATCTCATATA GTTTAAAGA GAAAGAAATA AAAC AAGAAG GTAGACTTTT 10300
TGCAAAAATG ACATACAAGA TGAGGGCTAC ACAAGTATTA TCAGAAACAT TATTGCGGAA 10360
TAATATAGGG AAATCTCTCC AAGAGAATGG GATGGTTAAA GGAGAAATGG AATTACTCAA 10420
GAGACTAACA ACAATATCTA TGTCTGGAGT TCCGCGGTAT AATGAGGTAT ACAATAATTC 10480
AAAAAGTCAC ACAGAAGAAC TTCAAGCTTA TAATGCAATT AGCAGTTCCA ATTTATCTTC 10540
TAATCAGAAG TCAAGAAGT TTGAATTTAA ATCTACA GAT ATATACAATG ATGGAATACG 10600
AACCCTAAGC TGCTTTCTAA CGACAGATCT TAAAAAATAT TGTTTAAATT GGAGGTATGA 10660
ATCAACAGCT TTATTCGGTG ATACTGTAA TCAGATATTT GGGTTAAAGG AATTATTTAA 10720
TTGGCTGCAC CCTCGCCTTG AAAAGAGTAC AATATAT GTT GGAGATCCTT ATTGCGCGCC 10780
ATCAGATATT GAACATTATC CACTTGATGA CCATCCTGAT TCAGGATTTT ATGTTATATA 10840
TCCTAAAGGA GGAATAGAAG GGTTTTGCCA AAAGTTA TGG ACATCTATAT CTATCAGTGC 10900
TCAACATTTA GCAGCTGTCA AAATCGGTTG AAGAGTTACT GCAATGGTTC AAGGGGATAA 10960
TCAGCGCAT GCTGTTACCA CAAGAGTACC TAATAAT TAT GATTATAAAG TTAAGAAAGA 11020
GATTGTTTAT AAAGATGTGG TAAGATTTTT TGATTCC TTG AGAGAGGTGA TGGATGATCT 11080
GGGTCAATGAG CTCAACTAA ATGAACTAT AATAAGTAGT AAAA TGTTTA TATATAGCAA 11140
AAGGATATAT TATGACGGAA GAATCCTTCC TCAGGCA TTA AAAGCATTTG CTAGATGTGT 11200
TTTTGTGCTC GAAACAATCA TAGATGAGAC AAGATCA GCA TCCTCAAATC TGGCTACATC 11260
GTTTGCAAG GCCATTGAGA ATGGCTACTC ACCTGTA TTG GGATATGTAT GCTCAATCTT 11320
CAAAAATATC CAACAGTTGT ATATAGCGCT TGGAAATGAAT ATAAACCCAA CTATAACCCA 11380
AAATATTAAG GATCAATAT TCAGGAATAT TCATTGAGT CAATATGCCT CCTTAATCCC 11440
TGCTAGTGTG GGAGGATTTA ATTATATGGC CATGTCAAGG TGTTTGTGCA GAAACATTTG 11500
AGATCCTACA GTCGCTGCGT TAGCCGATAT TAAAGATT TT AAAAGCAA ATTTGTAGA 11560
TCGAGGTGTC CTTTACAGAA TTATGAATCA AGAACCAGGC GAGTCTCTTT TTTTAGACTG 11620
GGCCTCAGAT CCTATTTCAT GTAACCTTACC ACAATCT CAA AATATAACCA CCATGATAAA 11680
GAATATAACT GCAAGAAATG TACTACAGGA CTCACCAAAC CCATTACTAT CTGGATTATT 11740
TACAAGTACA 11750
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FIGURE 1E



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Serial No.: 09/900,112 Filing Date: July 5, 2001

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SEQ ID NO: 35

ATGATAGAAG AGGATGAGGA ATTAGCTGAG TTCCTAA TGG ACAGGAGAAT AATCCTCCCA 11810
AGAGTTGCAC ATGACATTTT AGATAATTCT CTTACTG GAA TTAGGAATGC TATAGCTGGT 11870
ATGTTGGGATA CAACAAAAT C ACTAATTGGA GTAGGGA TAA GCAGAGGAGG ATTA CCTAT 11930
AACTTATTAA GAAAGATAAG CAACTATGAT CTTGTACAAT ATGAGACACT TAGTAAACT 11990
TTAAGACTAA TAGTCAGTGA CAAGATTAAAG TATGAAGATA TGTGCTCAGT AGACC TAGCC 12050
ATATCATTAA GACAAAAAT GTGGATGCAT TTATCAGGAG GAAGAATGAT AAATGACTT 12110
GAAACTCCAG ATCCTTTAGA GTTACTGTCT GGAGTAA TAA TAACAGGATC TGAACATTGT 12170
AGGATATGTT ATTCACCTGA AGGTGAAAGC CCATATACAT TGAGTGATTT ACCAGGCAAT 12230
CTTAATATAG GATCAGCTGA GACAGGAATA GCATCAT TAA GGGTCCCTTA CTTTGATCA 12290
GTTACAGATG AGAGATCTGA AGCACAATTA GGGTATA TCA AAAATCTAAG CAAC CAGCT 12350
AAGGCTGCTA TAAGATAGC AATGATATAT ACTTGGGCACT TTGGGAATGA CGAAATATCT 12410
TGGATGGAAG CATCACAGAT TGCACAAACA CGTGCAAACT TTACATTGGA TAGCT TAAAG 12470
ATTTTGACAC CAGTGACAA C ATCAACAAAT CTATCACACA GGTAAAGA TACTGCTACT 12530
CAGATGAAT TTTCTAGTAC ATCACTTATT AGAGTAA GCA GGTTCATCAC AATAT CTAAT 12590
GATAATATGT CTATTAAAGA AGCAAAATGAA ACTAAAGAT A CAAATCTTAT TTATCAACAG 12650
GTAATGTTAA CAGGATTAA G TGTATTGAA TATCTAT TTA GGTAGAGGA GAGTA CAGGA 12710
CATAACCTTA TGGTCTGCA TCTACATATA GAGGATG GAT GTTGATATA AGAGA GTTAC 12770
AATGATGAGC ATATCAATCC GGAGTCTACA TTAGAG TTA TCAAAATACC TGAGAGTAAT 12830
GAATTATAT ATGATAAGGA CCTTTAAAG GATATAGATC TATCAAAAT AATGGTTATA 12890
AGAGATCATT CTTATACAA TGCATGAAT TACTGGGATG ACACAGATAT TGTACATGCA 12950
ATATCAATAT GTACTGCAGT TACAATAGCA GATACAA TGT CGCAGCTAGA TCGGATAAT 13010
CTTAAGGAGC TGGTTGTGAT TGCAAATGAT GATGATATT A ACAGTCTGAT AACTGAA TTT 13070
CTGACCCTAG ATATAGTAGT GTTTCTCAA ACATTGAGG GGTACTCGT GAATCAATTT 13130
GCATATACCC TTTATGGATT GAAATAGAA GGAAGGGATC CCATTGGGA TTATA TAATG 13190
AGAACATTAA AAGACACCT C ACATTCAGTA CTTAAAGTAT TATCTAATGC ACTA TCTCAT 13250
CCAAAGGTGT TAAGAGATT T TGGGATTGT GGAGTTT TGA ATCTATTTA TGGTCTAAT 13310
ACTGCTAGTC AAGATCAAGT TAAGCTTGCT CTCTCGA TTT GCGAGTACTC CTTGGATCTA 13370
TTTATGAGAG AATGGTTGAA TGGAGCATCA CTTGAGA TCT ATATCTGTGA TAGTGACATG 13430
GAAATAGCAA ATGACAGAAG ACAAGCATT CTCTCAAGAC ATCTTGCTGT TGTGTGTTGT 13490
TTAGCAGAGA TAGCATCTT TGGACCAAAT TTATTAAATC TAACATATCT AGAGA GACTT 13550
GATGAATTAA AACAACTACT AGATCTGAAC ATCAAGAAAG ATCTACTCT TAAATATGTG 13610
CAAGTATCAG GACTGTAA T TAAATCATTC CCTCAA CTG TTACGTATGT AAGGAAACT 13670
GCGATTAGT ATCTGAGGAT TCGTGTATT AATCGGCTG AAACGATTGA AGATTGGGAT 13730
CCCATAGAAG ATGAGAATAT CTTAGACAA ATTGTTAAAA CTGTAAATGA CAATTGCAT 13790
GATAATCAAA AGAGAATAA AAGTAGTTAT TTCTGGG GAT TAGCTCTAAA GAATTATCAA 13850
GTGTTGAAAA TAAGATCCAT AACGAGTAT TCTGAAGTTA ATGAAGCTTC GAATGTTACT 13910
ACACATGGAA TGACACTTCC TCAGGGAGGA AGTTATCTAT CACATCAGT GAGGT TATTT 13970
GGAGTAAACA GTACAGTTG TCTTAAAGCT CTTGAATAT CACAAATCTT AATGAGGGAA 14030
GTTAAAAAG ATAAAGATA G ACTCTTTTTA GGAGAAGGAG CAGGAGCATAT GTTAGCATGT 14090
TATGATGCTA 14100

FIGURE 1F



SEQ ID NO: 35

CACTCGGTCC TGCATAAAAT TATTATAATT CTGGTTTAAA TATTACAGAT GTAAT TGGTC 14160
AACGGGAATT AAAAATCTT C CCATCAGAAG TATCATTAGT AGGTAAAAAA CTAGGAAATG 14220
TAACACAGAT TCTTAATCGG GTGAGGGTGT TATTTAA TGG GAATCCCAAT TCAACATGGA 14280
TAGGAAATAT GGAATGTGAG AGTTTAATAT GGAGTGAATT AAATGATAAG TCAATTGGTT 14340
TAGTACATTG TGACATGGAG GGAGCGATAG GCAAATCAGA AGAAACTGTT CTACA TGAAC 14400
ATTATAGTAT TATTAGGATT ACATATTTAA TCGGGGATGA TGATGTTGTC CTAGT ATCAA 14460
AAATTATACC AACTATTACT CCGAATTGGT CTAAAAACT CTATCTATAC AAGTT GTATT 14520
GGAAGGATGT AAGTGTAGTG TCCCTTAAAA CATCAA TCC TGCCTCAACA GAGCT TTAAT 14580
TAATTTCAAA AGATGCTTAC TGTACTGTAA TGGAAACCAG TAATCTTGT TTTATCAAAAC 14640
TTAAAAGGAT ATCATCAATA GAAGAAAAATA ATCTATTAAA GTGGATAATC TTATCAAAAA 14700
GGAAGAATAA CGAGTGGTTA CAGCATGAAA TCAAAGAAGG AGAAAGGGAT TATGGGATAA 14760
TGAGGCCATA TCATACAGCA CTGCAAAATT TTGGATTCCA AATTAACTTA AATCACTTAG 14820
CTAGAGAATT TTTATCAACT CTGTATTAA CCAACATTA TAATATAATT CAAAGTTTAA 14880
CAAGACAAT TAAAGATGTT ATGTTTCAAT GGGTCAA TAT CACTCATGAC AATAAAGAC 14940
ATAAATTAGG AGGAAGATA ATCTATTCC CGCTTAAAA TAAGGGGAAA TTAAGATTAT 15000
TATCACGAAG ATTAGTACTA AGCTGGATAT CATTATCTCT ATCAACCAGA TTAAT GACGG 15060
GCCGTTTTCC AGATGAAAAA TTGAAAAATA GGGCACAGAC CGGATATGTA TCATT GGCTG 15120
ATATTGATT AGAATCCTTA AGTTTATTAT CAAGAAATA TGTCAAAAA TACAAGAAC 15180
ACATAGGATT AATATCATAC TGGTTTTTGA CCAAAGAGGT CAAAATACTA ATGAAGCTTA 15240
TAGGAGGAGT CAACTACTA GGAATTCCTA AACAGTCAA AGAGTTAGAG GATCGATCAT 15300
CTCAGGGTTA TGAATATGAT AATGAATTG ATATTGATTA ATACATAAAA ACATAAAAA 15360
AAACACCTAT TCCTCACCCA TTCACTCCA ACAAAT GAA AAGTAAGAAA AACAT GTAAT 15420
ATATATATAC CAAACAGAGT TTTTCTCTTG TTTGGT 15456

FIGURE 1G



SEQ ID NO: 36

ACCAACAAG AGAAGAGACT TGCTTGGGAA TATTAAT TCA AATAAAAT AACTTAGGAT 60
TAAAGAACCT TACCGAAGG TAAGGGGAAA GAAATCC TAA GACTGTAATC ATGTTGAGTC 120
TATTCGACAC ATCACTAGTGC CGTAGGCAGG AGAACATAAC GAAATCAGCT GGTGGGCGTG 180
TATTTCCCGG GCCAAAAAAC ACTGTGTCTA TATTTGCTCT TGGACCATCA ATAACAGATG 240
ACAATGATAA AATGACATTG GCTCTTCTCT TTTTGTCTCA TTCTTTAGAC AATGAAAGC 300
AGCATGCGCA AGAGCTGGGA TTTTGTGTTT CTCTGTTATC AATGGCTTAT GCCAACCCAG 360
AGAAAGACCC AGGAAGACAG AAATATGGTG GGTGTTGT CGT CAAGACTAGA GAGATGGTTT 480
ATGAAAAGAC AACTGATTGG ATGTTCCGGGA GTGATCT TGA GTATGATCAA GACAA TATGT 540
TGCAAAATGG TAGAAGCACT TCTACAATCG AGGATCT TGT TCATACTTTT GGATA TCCAT 600
CGTGTCTTGG AGCCCTTATA ATCCAAGTTT GGATAATACT TGTT AAGGCT TGCAT GACGA 660
TATCAGGATT GAGGAAAGGA TTCTTTACTC GGTAGAAAGC ATTTCCGACA GATGGAACAG 720
TAAATCCAG TCTAGTGTG AGCGGTGATG CAGTAGAACA AATTGGATCA ATTAT GAGGT 780
CCCAACAGAG CTTGGTAACA CTCATGGTTG AAACACTGAT AACAATGAAC ACAGG CAGGA 840
ATGATCTGAC AACATAGAA AAGAATATAC AGATTGT AGG AAACACTACAT TACAT GTCAG 900
GTCTTGCTTC ATTTTTCAC ACAATCAGAT ATGGCAT TGA GACTAGAA TG CAGCG TCTAA 960
CTCTGTCTAC CCTTAGACCG GATATCAACA GACTCAAAGC ACTGATCGAG TTATA TCTAT 1020
CAAGGGGGCC ACGTGCTCTT TTTATATGCA TTTTGAGAGA TCCCGTGCA TGGTGGT TTTG 1080
CAGCAGGCAA CTATCTTGC CTCTGGAGTT ATGCGAT GGG TGTAGCAGTT GTACA AAACA 1140
AGGCCATGCA ACAGTATGTA ACAGGAAGGT CTTATCT GGA TATTGAAATG TTCCA ACTTG 1200
GTCAAGCAGT GGCACGTGAT GCCAGTCCG AGATGAG TTC AATATTAGAG GATGAAC TGG 1260
GGGTACACA AGAAGCCAA GAAAGCTTGA AGAAACA CAT GAAGAATCAT AGCAG TTCAG 1320
ATACAACCTT TCATAAGCCT ACAGGGGGAT CAGCCATAGA AATGGCGATA ATGAAGAAG 1380
CAGGGCAGCC TGAATCCAGA GGAGATCAGG ATCAAGGAGA TGAGCCTCGG TCATC CATAG 1440
TTCTTATGCT ATGGG CAGAG GAAACCGGGA ATGACAATCA AACTGAATCA ACTACAGAAA 1500
TTGACAGCAT CAAACTGAA CAAAGAAACA TCAGAGACAG GCTGAACAAA AGACT CAAG 1560
AGAAAGGAAA ACAGAGTGAC CCGAGATCAA CTGACAT CAG AACACACACA AATCAAACTG 1620
AAATAGATGA TTTGTTCACT GCATTTCGGA GCAACTAGTC ACAAGAGAT GACCACTATC 1680
ACCAGCAACA AGTAAGAAAA ACTTAGGATT AATGGAAATT ATCCAATCCA GAGAC GGAAG 1740
GACAAATCCA GAATCCAAC CAACTCAAT CAACCAAAGA TTATGGAAG ACAAT GTTCA 1800
AAACAATCAA AACTGGATT CTTGGGAAGA GGGATCAGGA GATAAATCAT CTGAC ATCTC 1860
ATCGGCCCTC GACATCATTT AATTGATA CT CAGCACCAGC TCCCAA GAA ACACGGCAGA 1920
CAGCAATGAA ATCAACACAG GAACCAACAG ACTTAGCAGC ACAATCTACC AACCT GAATC 1980
CAAAACAACA GAAACAAGCA AGGAAATAG TGGACCA GCT AACAAATATC GACAG TTTGG 2040
GGCATCACAC GAACGTGCCA CAGAGACAAA AGATAGAAAT GTTAATCAGG AGACTGTACA 2100
GGGAGGATAT AGGAGAGGAA GCAGCCACAG TAGTAGAACT GAGACTATGG TCATC CGAAG 2160
AATCTCCAGA AGCAGGCCAG ATCTTAACAA TGGAACCAA ATCCAGGAAG ATATT GATTA 2220
CAATGAAGTT GGAGAGATGG ATAAGGACT TACTAAG AGG GAAATGCGAC AATT AAAGA 2280
TGTTCCAGTC AAGGTATCAG GAAGTGATGC CATCTCTCCA ACAAACAAG ATGGAGACGG 2340
TGATGATGGA 2350

FIGURE 2A



Docket No.: NIH-0127
Inventor: Mario H. Skiadopoulos et al.
Title: ATTENUATED HUMAN-BOVINE
CHIMERIC PARAINFLUENZA VIRUS (PIV)
VACCINES Page 9 of 27
Serial No.: 09/900,112 Filing Date: July 5, 2001

SEQ ID NO: 36

AGAGGCCCTGG AATCTATCAG TACATTGTAT TCAGGATATA CCAGTATAGT GACTGCCCA 2410
ACACTAGATG ACGAAGAAGA ACTCTTATG AAGAACAACA GGCCAAGAAA GTATCAATCA 2470
ACACCCACAGA AAGGTGACAA GGGAAATTAA AAGGGGTTG GAAGGCCAAA AGACA CAGAC 2530
AAACAATCAT CAATATTGGA CTACGAACCT AACTTCAAAG GATCGAAGAA GAGCCAGAAA 2590
ATCCTCAAAG CCAGCAGCAA TACAGGAGAA CCAACAAAGAC CACAGAATGG ATCCAGGGG 2650
AAGAGAATCA CATCTGGAA CATCTCAAC AGCGAGAGCG GCAATCGAAC AGAATCAACA 2710
AACCAAAACC ATCAGACATC AACCTCGGGA CAGAACCACA CAATGGGACC AAGCAAGAACA 2770
ACCTCGOACG CAAGGATCAA GACACAAAAG ACGGATG GAA AGGAAAGAGA GGACA CAGAA 2830
GAGAGCACTC GATTACAGA AAGGGCGATT ACATTAT TAC AGAATCTTGG TGTAATCCAA 2890
TCTCGACAA ATTAGACCT ATACCAAGAC AAGAGAG TTG TGTGTGTGGC GAATGTCTTA 2950
AACAAATGCG ATACTGCATC AAAGATAGAC TTCTTAGCAG GTTTGATGAT AGGAGTGTCA 3010
ATGGATCATG ATACCAAAT AAATCAGATT CAGAACGAGA TATTAAAGTTT GAAAACTGAT 3070
CTTAAAAAGA TGGATGAATC ACATAGAAGA CTAATTGAGA ATCAAAAAGA ACAATATCA 3130
CATGACATAT CATTAACTCTC AAATCTTAAA ATTATGACAG AGAGAGGAGG GAAGAAGGAC 3190
CAACCAGAAC CTAGCGGGAG GACATCCATG ATCAAGA CAA AAGCAAAAAG AGAGAAATA 3250
AAGAAAGTCA GTTTTGACCC TCTTATGGAA ACACAGGGCA TCGAGAAAAA CATCCCTGAC 3310
CTCTATAGAT CAATAGAGAA AACACAGAA AAGCACA CAC AGATCAAAATC AGAAAATAAC 3370
AGATTGAATG ATGAATCCAA TGCCACTAGA TTAGTACCTA GAAGAAATAAG CAGTACAATG 3430
AGATCATTA TAATAATCAT TAACAACAGC AATTATCAT CAAAAGCAA GCAATCATAC 3490
ATCAAGAAC TCAAGTCTG CAAGAGTGAC GAGGAAG TGT CTGAGTTGAT GGACA TGTCT 3550
AATGAGGATG TCAGTCCCA GTAAACCGCC AACCAAGGCT CAACACCAAG AAAACCAATA 3610
GCACAAAACA GCGAATCAGA GACCACCCCA ATACACC AAA CCAATCAACA CATAA CAAAG 3670
ATCTCCAGAT CATAGATGAT TAAGAAAAAC TTAGGAT GAA AGGACTAATC AATCTCCGA 3730
AACAAATGAG ATCACCACCT CCACAATCTA CACATTC CCA GAATCTCTT TCTCCGAGAA 3790
TGGCAACATA GAGCCGTTAC CACTCAAGGT CAATGAACAG AGAAAGGCCA TACCTCATAT 3850
TAGGGTTGTC AAGATAGGAG ATCCGCCCAA ACATGGATCC AGATAICTGG ATGTCTTTTT 3910
ACTGGGCTTC TTTGAGATGG AAAGGTCAA AGACAGG TAT GGGAGCATAA GTGATCTAGA 3970
TGTGATCCA AGTTACAAGG TTTGTGGCTC TGGATCATG CCACTTGGGT TGGCTAGATA 4030
CACCGAAAT GATCAGGAAC TCCTACAGGC TGCAACCAA GCTGATATAG AAGTAAGAAG 4090
AACTGTAAG GCTACGGAGA TGATAGTTTA CACTGTACA AACATCAAC CTGAACATA 4150
TCGATGTCC AGTAGATTA GAAAAGGGAT GTTATTT GAC GCTAATAAGG TTGCACTTGC 4210
TCCTCAATGT CTTCCTACTAG ATAGAGGGAT AAAATTCAGG GTGATATTTG TGAACCTGAC 4270
AGCAATTTGA TCAATAACTC TATTCAAAAT CCCTAAGTCC ATGGCATTGT TATCATTTGC 4330
TAATAAATA TCAATAAATC TACAAGTACA TATCAAAAACA GGAGTTCAGA CAGATTCCAA 4390
AGGAGTAGTT CAGATTCTAG ATGAAAAAGG TGAATAA TCA CTAATTTCA TGGTTCTCT 4450
CGGGTTGATC AAAAGGAAGA TGGGCGAAT GTACTCA GTT GAATATTGTA AGCAGAAGAT 4510
CGAGAAGAT AGATTATTAT TCTCATTGGG ATTATTT GGA GGGATCAGCT TCCACGTCAA 4570
CGCAACTGGC TCTATATCAA AGACATTAGC AAGTCAA TTA GCATTCAAAA GAGAAATCTG 4630
CTATCCOCTA ATGGATCTGA ATCCACACT AAATTCAGTT ATATGGGACT CATCAGTTGA 4690
AATTACAAGG 4700

FIGURE 2B

SEQ ID NO: 36

GTAGATGCAG TTCTCCAGCC TTCATTACCT GGCGAAT TCA GATACTACCC AAACATCATA 4760
 GCAAAAGGGG TCGGGAAAA T CAGACAGTAA AATCAACAAC COTGATATCC AACAT TGCAG 4820
 ATCAGGCTAC CCACAGGAGA AAAATCAAAA ACTTAGTATC AAAGGGATCA CCACGAACCC 4880
 CGGAAAACAG CCAAAACAAA CAACACACAA ATCAGAGACA AAAAGGAGAA GGCACTGCAG 4940
 AGACCGAGAA AAAACAGAAC GCACACAAACC AAGCAGAGAA AAGCCAAAGC CCGCC ATTCA 5000
 CAACACACACC AACAATCCTG CAAACAAGCA CCAAAACAGA GGTCAAAAGA CAAGAGCAC 5060
 CAGATATGAC CATCAACAACC ACAATCATAG CGATATTACT AATACCCCCA TCATT TTGTC 5120
 AATAGACAT AACAAAACTG CAACGTGTAG TGTGTTT AGT CAACAATCCT AAGGCATGA 5180
 AGATTTCACA AAATTTGCAA ACGAGATACC TGATATT AAG TTGATACCC AAAATAGAGA 5240
 ATTACACATC ATGTGGGGAT CAACAGATAA ACCAATA CAA GAAGTTATTG GATAGATTGA 5300
 TAATTCCTCT ATATGATGGA TTAATAATTAC AAAAGATGT AATAGTAGTA AGTCATGAAA 5360
 CCCACAACAA TACTAATCTT AGGACAAAAC GATTCTT TGG AGAGATAATT GGGCAATTG 5420
 CGATAGGAGT AGCCACTTCA GCACAAATCA CCGCAGCATG CGCTCTTGTC GAAGTAAAC 5480
 AGGCAAGATC AGACATAGAA AAACCTCAAG AGGCTAT AAG AGACACAAAC AAGGCAGTAC 5540
 AATCGATTCA AAGTTCTGTA GGTAACCTAA TTGTTGCA GT TAAATCAGTT CAAGACATG 5600
 TCACAATGA AATTATACCT TCAATACAAA GATTAGCTG TGAAGCAGCA GGGTTACAAT 5660
 TGGGAATTGC ATTGACACAA CATTACTCAG AATTAAAC AAA TATATTTGGT GATAA TATAG 5720
 GAACACTGAA AGAAAAAGGG ATAAAATTAC AAGGGATAGC ATCATTATAT CACACAAACA 5780
 TAACGGAAAT ATTTACTACT TCAACAGTTG ACCAATA TGA TATTTATGAC CTATT ATTCA 5840
 CTGAGTCAAT CAAGATGAGA GTGATAGATG TTGATTT GAG TGATTACTCA ATTAC TCTTC 5900
 AAGTTAGACT TCCTTTAATA ACTAAACTAT CAAATAC TCA AATTTATAAA GTAGA TTCTA 5960
 TATCATACAA CATCCAGGGC AAAGAGTGGT ATATTCCTCT TCCCAATCAC ATCATGACAA 6020
 AAGGGGCTTT TCTAGGTGGT GCTGATATTA AAGAATGCAT AGAGGCATTC AGCAGTTATA 6080
 TATGTCTTTC TGATCCAGGT TACATATTAA ATCAGAGAT AGAGAATTGT TTATCAGGGA 6140
 ACATAACACA GTGCTCTAAG ACTGTTGTTA CATCAGATGT GGTACCAGCA TACGCGTTTG 6200
 TGAATGGTGG ATTAATTGCA AACTGCATAA CAACTACATG TACATGCAAT GGAAT TGACA 6260
 ATAGAATTAA TCAATCACCT GATCAAGGAA TTAAGATCAT AACACATAAA GAATGCCAGG 6320
 TAATAGGTAT AAACGGAATG TTATTCAATA CTAATAGAGA AGGGACATTA GCAAC TTATA 6380
 CATTTGATGA CATCATATTA AATAACTCTG TTGCACTTAA TCCAATTGAT ATATCTATGG 6440
 AACTCAACAA GGCAAAACTA GAATTAGAAG AATCGAAGGA ATGGATAAAG AAATCAAAATC 6500
 AAAAGTTAGA TTCCGTTGGA AGTTGGTATC AATCTAGTGC AACATCACC ATATCATAG 6560
 TGATGATAAT AATTCTAGTT ATAAATCAATA TAACAT TAT TGTAGTCATA ATCAATATCC 6620
 ATAGAATTCA GGGGAAAGAT CAAAACGACA AAAACAGTGA CGCGTATATA CTGACAAATA 6680
 GACAAATAGA CTATACACGA TCAATATATA AAAGTACAAA AAACTTAGGA ACAAGGTTGT 6740
 TCAACACAGC AGCACCGAAT AGACCAAAAG GCAGCGCAGA GGGCAGACCA AACTCAAAAA 6800
 TGGAAATATT GAAACACACA AACAGCATAA ATAACACCAA CAATGAACCC GAAACAGCCCA 6860
 GAGGCAACAA TAGTAGCAAG GTTACAAATA TCATAAT GTA CACCTTCGCG ACAATAACAT 6920
 TAACAAATATT ATCAGTCATT TTTATAATGA TATTGACAAA CTTAATTCAA GAGAACAAATC 6980
 ATAATAAATT AATGTTGCAG GAAATAAGAA AAGAATT CGC GGCAATAGAC ACCGAATGTC 7040
 AGAGGACTTC 7050

FIGURE 2C



Docket No.: NIH-0127
Inventor: Mario H. Skiadopoulos et al
Title: ATTENUATED HUMAN-BOVINE
CHIMERIC PARAINFLUENZA VIRUS (PIV)
VACCINES Page 11 of 27
Serial No.: 09/900,112 Filing Date: July 5, 2001

09900112.101502

SEQ ID NO: 36

GGATGACATT GGAACCTCAA TACAGTCAGG AATAAATACA AGACTTCTCA CAATT CAGAG 7110
TCATGTTCAA AACTATATCC CACTATCATT AACACAA CAA ATGTCAGATC TCAGAAATTT 7170
TATCAATGAT CTAACAAATA AAAGAGAACA TCAAGAA GTG CCAATACAGA GAATGACTCA 7230
TGATAGAGGT ATAGAACCCC TAAATCCAAA CAAGTT CTGG AGGTGTACAT CTGG TAACCC 7290
ATCTCTAACA AGTAGTCTTA AGATAAGGTT AATACCA GGA CCAGGTTTAT TAGCAACATC 7350
TACTACAGTA AATGGCTGTA TTAGAATTC ATCGTTAGTA ATCAATCATC TAATC TATGC 7410
TTACACCTCT AATCTTATTA CCCAGGGCTG TCAAGAT ATA GGGAAATCTT ACCAAGTACT 7470
ACAAATAGGG AATAATTACTA TAAAT TCGGA CCTAGTACCT GATTTAAACC CCAGAGTCAC 7530
ACATACATTT AATATTGATG ATAATAGAAG ATCTTGC TCT CTGGCACTAT TGAATACAGA 7590
TGTTTATCAG TTATGCTCAA CACCAAAAGT TGAATGAAA TCCGATTATG CATCAACAGG 7650
TATTGAGGAT ATTGTACTTG ACATTGTGCAC TAATAAT GGA TTAATTATAA CAACAAGGTT 7710
TACAAATAAT AATATAACTT TTGATAAACG GTATGCA GCA TTGTATCCAT CAGTGGGACG 7770
AGGAATCTAT TATAAGGATA AAGTTTATAT TCTCGGATAT GAGGCTCTAG AGCATGAGA 7830
AAACGGAGAC GTAATATGTA ATACAACCTGG TTGTCTG GC AAAACACAGA GAGACTGTAA 7890
TCAGGCTTCT TATAGCCCAT GGTCTCAA TAAGGAAATG GTAAACTCTA TTATTGTTGT 7950
TGATAAAGGC ATAGATGCAA CTTTTAGCTT GAGGGTG TG ACTATTCCAA TGAGCCAAAA 8010
TTATTGGGGA TCAGAAAGGA GATTACTTTT ATTAGTG GAC AGAATATACA TATATACTAG 8070
ATCCACAAGT TGGCACAGTA AATTACAGTT AGGGTAATT GATATTTCTG ATTACTTAA 8130
TATAAGAATA AATTGGAATT GGCATAATGT ACTATCACGG CCAGGGAATG ATGAATGTCC 8190
ATGGGGTCAT TCATGCCGAC ACGGATGTAT AACAGGAGTT TACACTGATG CATATCCGCT 8250
AAACCCATCG GGGAGTGTG TATCATCAGT AATTCTT GAT TCACAAAAGT CTAGAGAAAA 8310
CCCAATCATT ACTTACTCAA CAGCTACAAA TAGAATAAAT GAATTAGCTA TATATAACAG 8370
AACCTTCCA GCTGCATATA CAACAACAAA TTGTATCACA CATTATGATA AAGGGTATTG 8430
TTTTCATATA GTAGAAATAA ATCACAAGG TTTGAATCG TTTCACCTA TGTTATTCAA 8490
AACAGAAGTT CCAAAAACCT GCAGCTAAAT TGATCAT CGC ATATCGGATG CAAGATGACA 8550
TTAAAAGAGA CCACGACAGA GACAACACAG GAGACGATGC AAGATATAAA GAAATATAAA 8610
AAACTTAGG AGAAAAGTGT GCAAGAAAAA TGGACAC CGA GTCCACAGC GGCACAAACT 8670
CTGACATTCT GTACCCGTGA TGTCAACCTCA ATTCTCCTAT AGTTAAAGGA AAGATAGCAC 8730
AACTGCATAC AATAATGAGT TTGCCTCAGC CCTAGCATAT GGATGAT GAT TCAATACTGA 8790
TTATTACTAG ACAAAAAATT AAACCTCAATA AATTAGATAA AAGACACCG TCAATTAGGA 8850
AATTAAGATC AGTCTTAATG GAAAGAGTAA GTGATCTAGG TAAATATACC TTTATCAGAT 8910
ATCCAGAGAT GTCATGTGAA ATGTTCCAAT TATGTATACC CGGAATTAAT AATAAAATAA 8970
ATGAATTGCT AAGTAAAGCA AGTAAACAT ATAATCAAAAT GACTGATGGA TTAAGAGATC 9030
TATGGGTTAC TATACTATCG AAGTTAGCAT CGAAAAA TGA TGGAAAGTAAT TATGATATCA 9090
ATGAAGATAT TAGCAATATA TCAAAATGTC ACATGACTTA TCAATCAGAC AAATGGGTATA 9150
ATCCATTCAA GACATGGTTT ACTATTAAGT ATGACATGAG AAGATTACAA AAGGCCAAAA 9210
ATGAGATTAC ATTCAATAGG CATAAAGATT ATAATCT ATT AGAAGACCAA AAGAAATATAT 9270
TGCTGATACA TCCAGAACTC GTCTTAATAT TAGATAAACA AATTACAAAT GGGTATATAA 9330
TGACTCTGGA ATTTGGTACTA ATGTATTGTG ATGTAGT TGA AGGGAGGTGG AATATAAGTT 9390
CATGTGCAAA 9400

FIGURE 2D



09900112 001500

SEQ ID NO: 36

ATTGGATCTC AAGTTACAAT CAATGTATTA TAAGGGTAAC AATTATATGGG AAATAATAGA 9460
TGGACTATTC TOGACCTTAG GAGAAAGAAC ATTTGACATA ATATCACTAT TAGAACCACT 9520
TGCATTATCG CTCATTCAAA CTTATGACCC GGTAAACAG CTCAGGGGGG CTTTTTAAAA 9580
TCACGTGTTA TCAGAAATGG AATTAATATT TGCAGCTGAG TGTACAACAG AGGAATATACC 9640
TAATGTGGAT TATATAGATA AAATTTTAGA TGTGTTCAAA GAATCAACAA TAGATGAAAT 9700
AGCAGAAATT TTCTCTTCT TCCGAACCTT TGGACACCTT CCATTAGAGG CGAGTATAGC 9760
AGCAGAGAAA GTTAGAAAGT ATATGTATAC TGAGAAATGC TTGAAATTTG ATACTATCAA 9820
TAAATGTCAT GCTATTTTTT GTACAATAAT TATAAATGGA TATAGAGAAA GACATGGTGG 9880
TCAATGGCCT CCAGTTACAT TACCTGTCCA TGCACATGAA TTTATCATAA ATGCAATACG 9940
ATCAATTTCT GCCATATCAT ATGAGAATGC TGTAGATAT TATAAGAGCT TCATAGGAAT 10000
AAAATTTGAC AAGTTTATAG AGCCTCAATT GGATGAA GAC TTAATATTTT ATATGAAAGA 10060
TAAATGATTA TCCCCAAAGA AATCAAACTG GGACACAGTC TATCCAGCTT CAACCTGTGT 10120
ATACCGCACT AATGTGTCTC ATGATTACAG AAGATTGTTT GAAGTATTTA TAGCAGATAG 10180
TAAATTTGAT CCCACCAAG TATTAGATTA CGTAGAATCA GGATATTGGC TGGATGATCC 10240
TGAATTTAAT ATCTCATATA GTTTAAAGA GAAAGAAATA AAACAAAGAG GTAGACTTTT 10300
TGCAGAAATG TCATACAGA TGAGGGCTAC ACAAGTATTA TCAGAAACAT TATTGGCGAA 10360
TAATATAGGG AAATTTCTCC AAGAGAAATGG GATGGTTAAA GGAGAAATTG AATTAATCAA 10420
GAGACTAACA ACAATATCTA TGTCTGGAGT TCCGCGGTAT AATGAGGTAT ACAATAATTC 10480
AAAAAGTCAC ACAGAAAGAC TTCAAGCTTA TAATGCAATT AGCAGTTCCA ATTTATCTTC 10540
TAATCAGAAG TCAAGAAAGT TTGAATTTAA ATCTACAGAT ATATACAATG ATGGAATACG 10600
AACCCTAAGC TGCTTCTTAA CGACAGATCT TAAAAAATAT TGTTTAAATT GGAGGTATGA 10660
ATCAACAGCT TTAATCGGTG ATACTGTGTA TCAGATATTT GGGTTAAAGG AATTATTTAA 10720
TTGGCTGCAC CCTCGCCTTG AAAAGAGTAC AATATATGTT GGAGATCCTT ATTGCGCGCC 10780
ATCAGATATT GAACATTTAC CACTTGATGA CCATCCTGAT TCAGGATTTT ATGTTATCAA 10840
TCTTAAAGGA GGAATAGAAG GGTTTTGCCA AAAGTTATGG ACACTCATAT CTATCAGTGC 10900
AATACATTTA GCAGCTGTCA AAATCGGTGT AAGAGTTACT GCAATGGTTC AAGGGGATAA 10960
TCAGCGCATA GCTGTTACCA CAAGAGTACC TAATAATAT GATTATAAAG TTAAGAAAGA 11020
GATTGTTTAT AAGATGTGG TAAATTTTTT TGATTCCCTG AGAGAGGTGA TGGATGATCT 11080
GGGTCAATAG CTCAAACTAA ATGAAACTAT AATAAGTAGT AAAATGTTTA TATATAGCAA 11140
AAGGATATAC TATGACGGAA GAATCCTTCC TCAGGCAATTA AAAGCATTTG CTAGATGTGT 11200
TTTTTGCTCT GAAACAATCA TAGATGAGAC AAGATCAGCA TCCTCAAATC TGGCTACATC 11260
GTTTGCAAGG GCCATTGAGA ATGGCTACTC AOCCTGATTT GGATATGTAT GCTCAATCTT 11320
CAAAATATAT CAACAAATGT ATATAGCGCT TGGAAATGAA ATAAACCCAA CTATAGACAA 11380
AAATATTTAA GATCAATATT TCAGGAATAT TCATTGGATG CAATATGCCT CCTTAATCCC 11440
TGCTAGTGTC GGAGGATTTA ATTATATGGC CATGTCAAGG TGTTTTGTCA GAAACATTGG 11500
AGATCCTACA GTCGCTGCGT TAGCCGATAT TAAAGATTTT ATAAAAAGCAA ATTTGTTAGA 11560
TCAGGAGTGC CTTTACAGAA TTATGAATCA AGAACCAAGG GAGTCTTCTT TTTTATAGCTG 11620
GGCCTCAGAT CCTATTATCA GTAACTTACC ACAATCTCAA AATATAACCA CCATGATAAA 11680
GAATATAACT GCAAGAAATG TACTACAGGA CTCACCAAAC CCATTACTAT CTGGATTATT 11740
TACAAGTACA 11750

FIGURE 2E



09900112 101502

SEQ ID NO: 36

ATGATAGAAG AGGATGAGGA ATTAGCTGAG TTCCTAA TGG ACAGGAGAAT AATCCTCCCA 11850
AGAGTTGCAC ATGACATTTT AGATAATTCT CTACTGTGAA TTAGGAATGC TATAGCTGGT 11870
ATGTTGGATA CAACAAAAT C ACTAATTCGA GTAGGGATAA GCAGAGGAGG ATTAA CCTAT 11930
AACTATTAA GAAAGATAAG CAACATATGAT CTTGTACAA ATGAGACACT TAGTAAAACT 11990
TTAAGACTAA TAGTCAGTGA CAAGATTAAG TATGAAGATA TGTGCTCAGT AGACCTAGCC 12050
ATATCATTA GACAAAAAT GTGGATGCA TTAGCAGGAG GAAGAATGAT AATG GACTT 12110
GAAACTCCAG ATCCTTTAGT GTTACTGTCT GGAGTAA TAA TAACAGGATC TGAACATTGT 12170
AGGATATGTT ATCAACTGA AGGTGAAAGC CCAATATCAT GGATGTATTT ACCAGGCAAT 12230
CTTAATATAG GATCAGCTGA GACAGGAATA GCATCAT TAA GGGTCCCTTA CTTTGGATCA 12290
GTTACAGATG AGAGATCTGA AGCACAATTA GGGTATATCA AAAATCTAAG CAAAC CAGCT 12350
AAGGGTGCTA TAAGAATAG C AATGATATAT ACTTGGGCAT TTGGGAATGA CGAAATATCT 12410
TGGATGGAAG CATCAAGAT TGCACAAACA CGTGCAAACT TTACATTGGA TAGCTTAAAG 12470
ATTTTGACAC CAGTGACAA C ATCAACAAAT CTATCACACA GGTAAAAA TACTGCTACT 12530
CAGATGAAT TTTCTAGTAC ATCACTTATT AGAGTAA GCA GGTTCATCAC AATATCTAAT 12590
GATAATATGT CTATTAAAG AGCAAAATGAA ACTAAAGTA CAATCTTAT TTATCAACAG 12650
GTAATGTTAA AGATTAATAG TGTATTTGAA TATCTAT TTA GGTTAGAGGA GAGTAC CAGA 12710
CATAACCTTA TGGTCATGCA TCTACATATA GAGGATGGAT GTTGTATAAA AGAGA GTTAC 12770
AATGATGAGC ATATCAATC C GGAGTCTACA TTAGA GTTAA TCAAAATCCC TGA GAGTAA 12830
GAATTTATAT ATGATAAGGA CCGTTTAAAG GATATAGATC TATCAAAAT AATGGTTATA 12890
AGAGATCAAT CTTATACAA T TGACATGAAT TACTGGGATG ACACAGATAT TGTACATGCA 12950
ATATCAATAT GTACTGCAGT TACAATAGCA GATACAA TGT CGCAGCTAGA TCGGGATAAT 13010
CTTAAAGGAGC TGGTGTGAT TGCAAAATGAT GATGATATTA ACAGTCTGAT AACTGAA TTT 13070
CTGACCCTAG ATATACTAGT GTTCTCAAA ACATTTG GAG GGTACTCGT GAATCAATTT 13130
GCATATACCC TTTATGGATT GAAAATAGAA GGAAGGGATC CCATTTGGGA TTATA TAATG 13190
AGAACATTA AAGACACCT C ACATTCAGTA CTTAAAGTAT TATCTAATGC ACTACTCAT 13250
CCAAAAGTGT TTAAGAGATT TTGGGATGTT GGAGTTT TGA ATCCTATTTA TGGTCTAAT 13310
ACTGCTAGTC AAGATCAAGT TAAGCTTGCT CTCTGCA TTT GCGAGTACTC TTGGATCTA 13370
TTTATGAGAG AATGGTTGAA TGGAGCATCA CTTGAGATCT ATATCTGTGA TAGTGACATG 13430
GAAATAGCAA ATGACAGAAG ACAAGCATTT CTCTCAAGAC ATCTTGCCCT TGTGTGTT GT 13490
TTAGCAGAGA TAGCATCTT TGGACCAAA TATTAAAACT TAACATATCT AGAGA GACTT 13550
GATGAATTA AACAATACT T AGATCTGAAC ATCAAGAAAG ATCTACTCT TAAATATGTG 13610
CAAGTATCAG GACTGTAA T TAAATCATTC CCGTCAA CTG TTAGTATGT AAGGAAACT 13670
GCGATTAA GT ATCTGAGGA T TCGTGGTATT AATCCGCTG AAACGATTGA AGATTGGAT 13730
CCCATAGAAG ATGAGAATA CTTAGACAA ATTGTTAAAA CTGTAAATGA CAATTGCAT 13790
GATAATCAA AGAGAAATAA AAGTAGTTAT TTCTGGGAT TAGCTCTAAA GAATTATCAA 13850
GTCGTGAAAA TAAGATCCAT AACGAGTGAT TCTGAAGTAT ATGAAGCTTC GAATGTACT 13910
ACACATGGAA TGACACTTC C TCAGGGAGGA AGTTATCTAT CACATCAGCT GAGGT TATT 13970
GGAGTAAACA GTACAAGTTG TCTTAAAGCT CTTGAAT TAT CAAATCTT AATGAAGGAA 14030
GTTAAAAAAG ATAAAGATAG ACTCTTTTTA GGAGAAGGAG CAGGAGCTAT GTTAGCATGT 14090
TATGATGCTA 14100

FIGURE 2F



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09900112 101502

SEQ ID NO: 36

CACTCGGTCC TGCAATAAAT TATTATAATT CTGGTTTAAA TATTACAGAT GTAAT TGGTC 14160
AACGGGAATT AAAAATCTTC CCATCAGAAG TATCATTAGT AGGTAAAAAA CTAGGAAATG 14220
TAACACAGAT TCTTAATCGG GTGAGGGTGT TATTTAA TGG GAATCCCAAT TCAACATGGA 14280
TAGGAAATAT GGAATGTGAG AGTTTAATAT GGAGTGAATT AAATGATAAG TCAATTGGTT 14340
TAGTACATTG TGACATGGAG GGAGCGATAG GCAAAATCAGA AGAAACTGTT CTACATGAAC 14400
ATTATAGTAT TATTAGGATT ACATATTTAA TCGGGGATGA TGATGTTGTC CTAGTATCAA 14460
AAATTATACC AACTATTACT CCGAATTGGT CTAAAATACT CTATCTATAC AAGTTGTATT 14520
GGAAGGATGT AAGTGTAGTG TCCCTTAAAA CATCCAAATCC TGCCTCAACA GAGCTTTATT 14580
TAATTTCAAA AGATGCTTAC TGTACTGTAA TGGAAACCAG TAATCTGTGT TTATCAAAAC 14640
TTAAAGGAT ATCATCAATA GAAGAAAATA ATCTATTAAA GTGGATAATC TTATCAAAAA 14700
GGAAGAATAA CGAGTGGTTA CAGCATGAAA TCAAGAAGG AGAAAGGGAT TATGGGATAA 14760
TGAGGCCATA TCATACAGCA CTGCAAAATT TTGGATTCCA AATTAACCTA AATCACTTAG 14820
CTAGAGAATT TTTATCAACT CCTGATTTAA CCAACATTAA TAATATAATT CAAAGTTTTA 14880
CAAGAACAAT TAAAGATGTT ATGTTGCAAT GGGTCAA TAT CACTCATGAC AATAAAGAC 14940
ATAAATTAGG AGGAAGATAT AATCTATTCC CGCTTAAAA TAAGGGGAAA TTAAGATTAT 15000
TATCACGAAG ATTAGTACTA AGCTGGATAT CATTATCCTT ATCAACCAGA TTACTGACGG 15060
GCCGTTTTCC AGATGAAAAA TTTGAAAATA GGGCACAGAC CGGATATGTA TCATTGGCTG 15120
ATATTGATTT AGAATCCTTA AAGTTATTAT CAAGAAATAT TGTCAAAAAT TACAAGAAC 15180
ACATAGGATT AATATCATAC TGGTTTTTGA CCAAGAAGG CAAAATACTA ATGAAGCTTA 15240
TAGGAGGAGT CAAACTACTA GGAATTCCTA AACAGTACAA AGAGTTAGAG GATCGATCAT 15300
CTCAGGGTTA TGAATATGAT AATGAATTG ATATTGATTA ATACATAAAA ACATAAATA 15360
AAACACCTAT TCCTCACCCA TTCACCTCCA ACAAATGAA AAGTAAGAAA AACATGTAAT 15420
ATATATATAC CAAACAGAGT TTTTCTCTTG TTTGGT 15486

FIGURE 2G



FIG. 3A

Mutagenesis to create restriction sites at start and stop condons of N

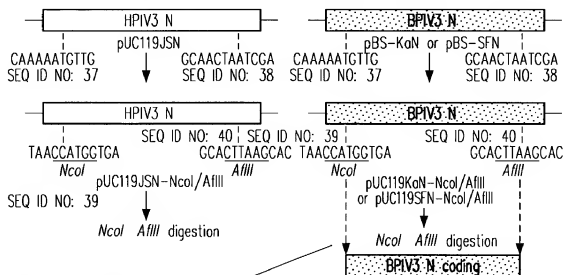


FIG. 3B

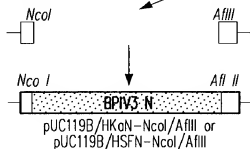


FIG. 3C

Mutagenesis to restore start and stop codon context

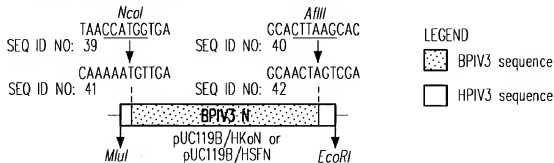




FIG. 4A

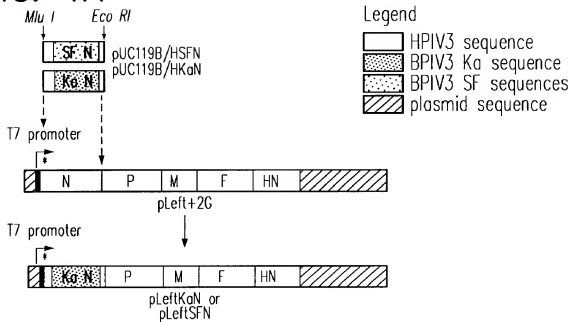


FIG. 4B

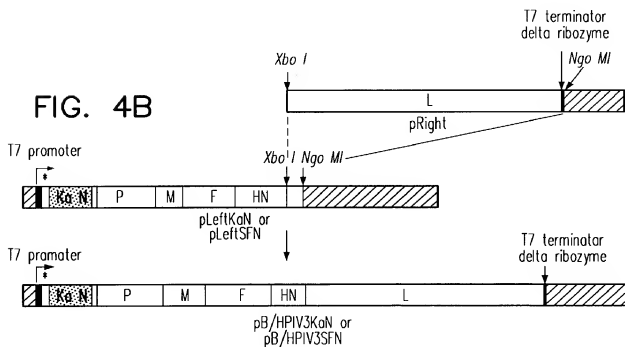




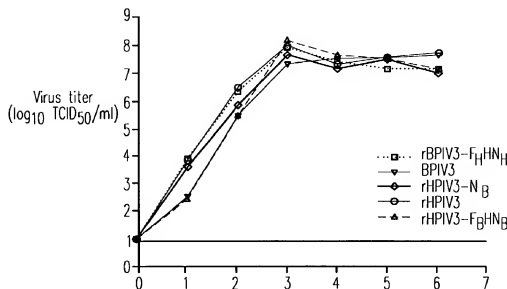
FIG. 5A

SEQ ID NO: 43	rJS	GGAAC TCTATAATTTCAAAAATGTTGAGCCTATTGATAC
SEQ ID NO: 44	cKa	GGAAC TCTATAATTTCAAAAATGTTGAGCTATTTCGACAC
SEQ ID NO: 45	cSF	GGAAC TCTATAATTTCAAAAATGTTGAGCTATTTCGACAC
SEQ ID NO: 46	Ka	GAAATCCTAAGACTGTAAATCATGTTGAGTCTATTTCGACAC
SEQ ID NO: 47	SF	GAAATCCTAAGACTGTAAATCATGTTGAGTCTATTTCGACAC

FIG. 5B

SEQ ID NO: 48	rJS	TTAACGCATTGGAAGCAACIAATCGAATCAACATTTTAA
SEQ ID NO: 49	cKa	TCAGTGCAATTCGGAAGCAACTAGTCGAATCAACATTTTAA
SEQ ID NO: 50	cSF	TCAGTGCAATTCGGAAGCAACTAGTCGAATCAACATTTTAA
SEQ ID NO: 51	Ka	TCAGTGCAATTCGGAAGCAACTAGTCACAAAGAGATGACCA
SEQ ID NO: 52	SF	TCAGTGCAATTCGGAAGCAACTAGTCACAAAGAGATGACCA

FIG. 13



Confirmation of identity of potential BPiV3/HPIV3 chimeras by *TaqI* digestion

Figure 6A

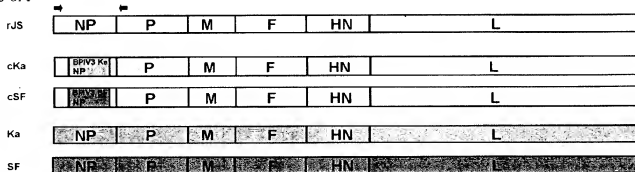


Figure 6B

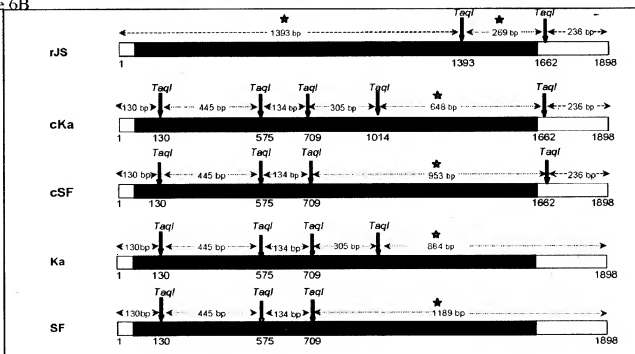


Figure 6C

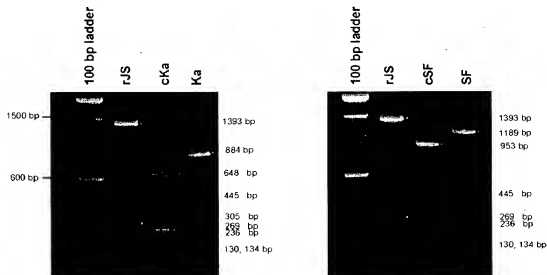




FIG. 7A

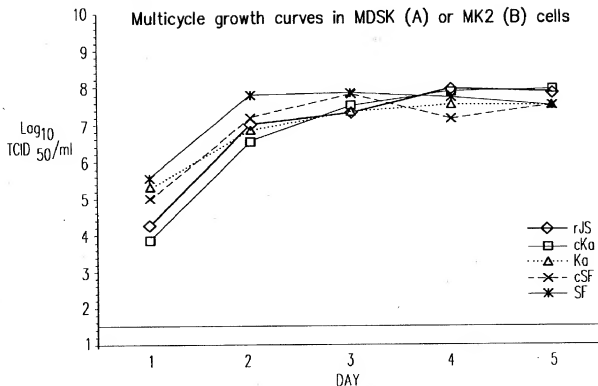
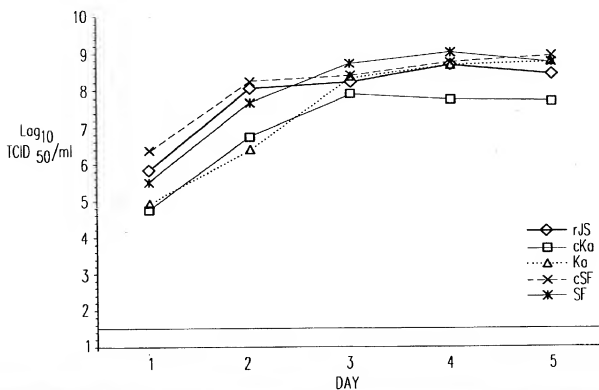


FIG. 7B





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0940059417 401502

FIG. 8A

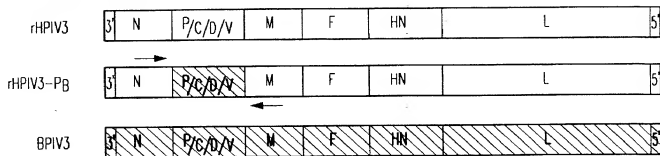


FIG. 8B

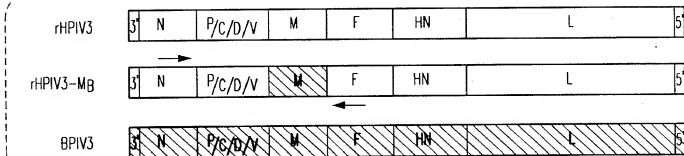
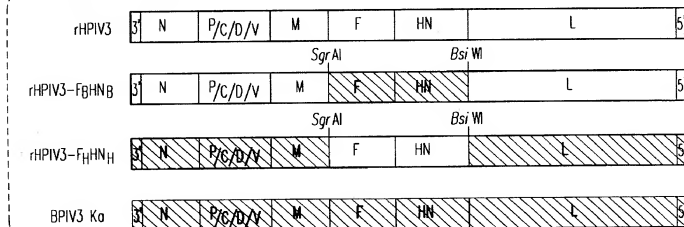


FIG. 11A



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Figure 9A

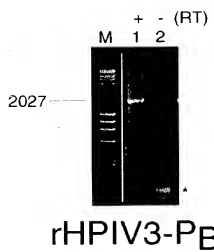


Figure 9B

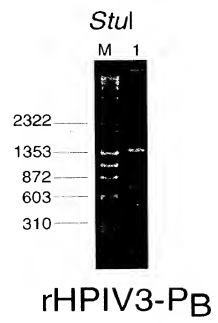
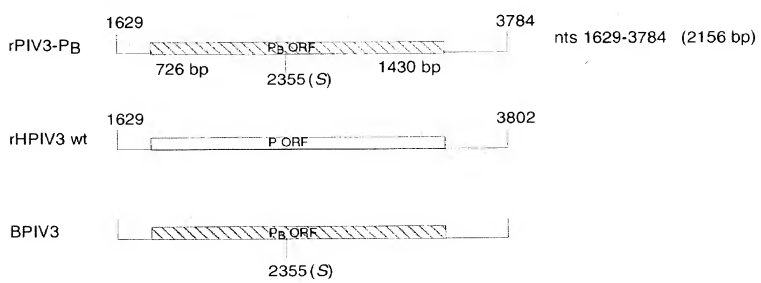


Figure 9C

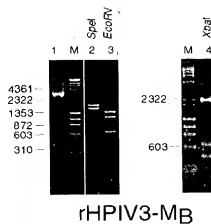


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Figure10A

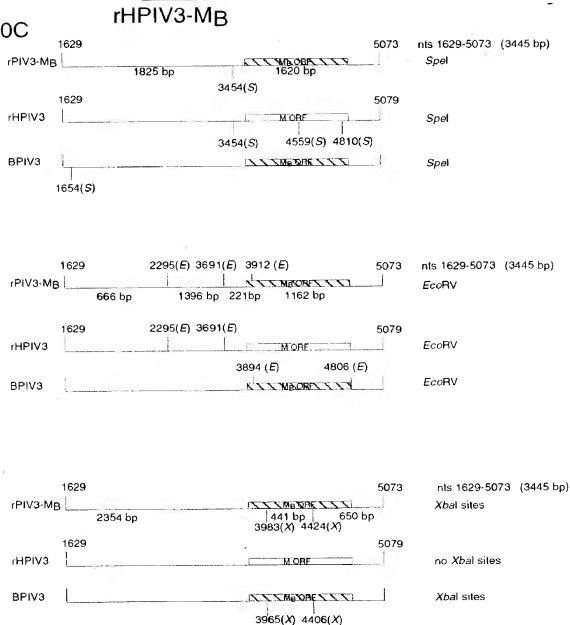


Figure10B



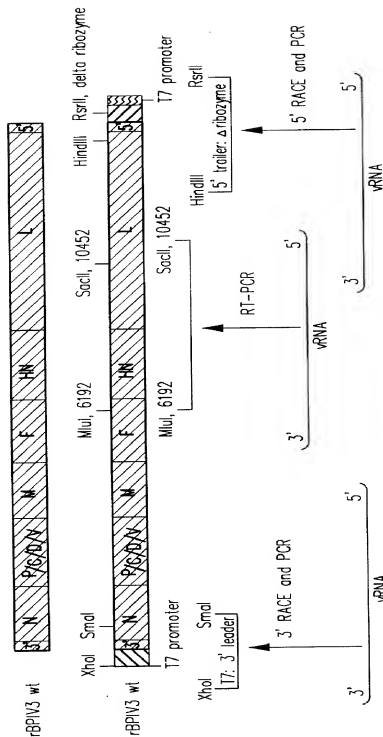
rHPIV3-MB

Figure10C





Assembly of an antigenomic cDNA for BPIV3 Ka



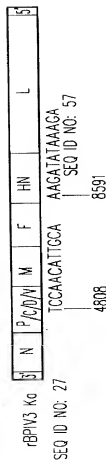
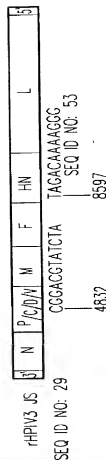


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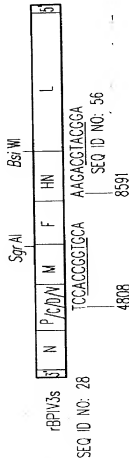
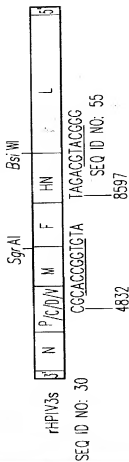
FIG. 11C

Generation of full length cDNA clones encoding HPV3/BBPV3 antigenic chimeric viruses

Generation of HPV3 and BBPV3 full length clones



Mitogenesis to create unique SgrAI and BstWI restriction sites



3. Cloning of the F and HN genes into the heterologous full length cDNA

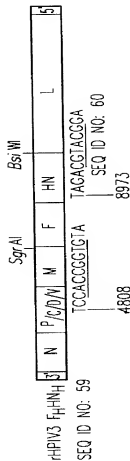
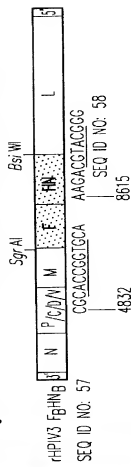
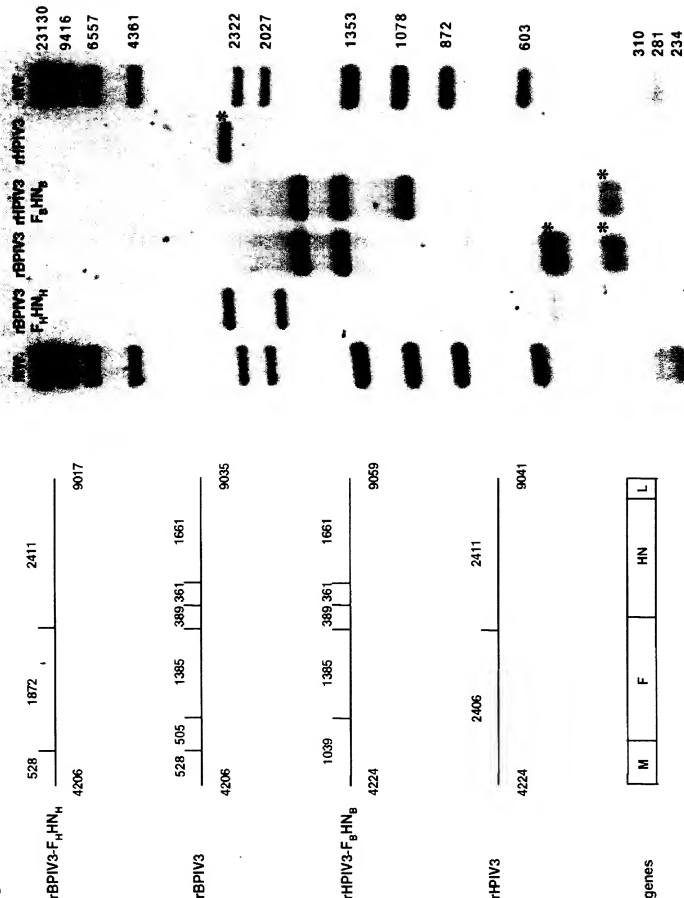


Figure 12



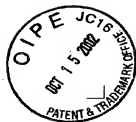


FIG. 14A

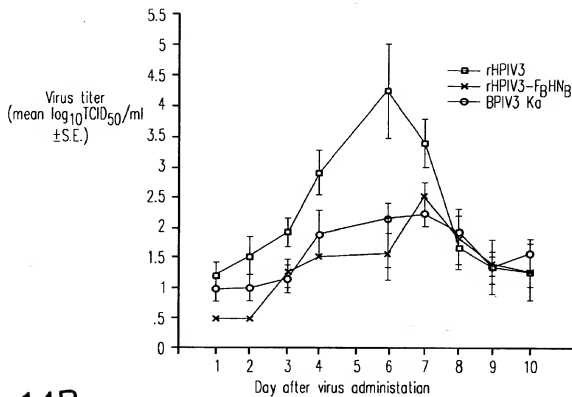


FIG. 14B

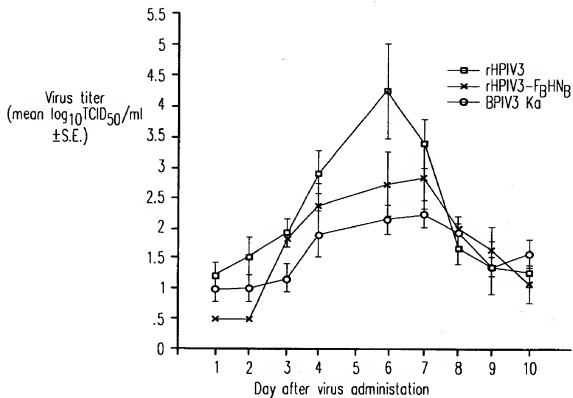




FIG. 15

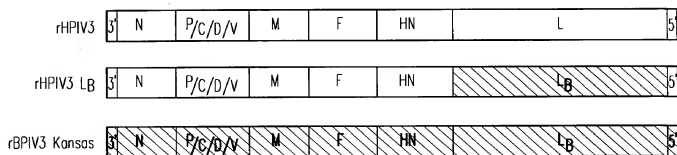


FIG. 16

L START

SEQ ID NO: 61 rHPIV3 WT 8623 5' TAGGACCAAAGCGTCTCGGAAATGGACACTGAATCTAACA 3' 8664

SEQ ID NO: 62 rHPIV3 LB 8623 5' TAGGACCAAAGCGTCTCGGAAATGGACACCGAGTCCCACA 3' 8664

SEQ ID NO: 63 rBPIV3 wt 8617 5' TAGGAGAAAAGTGTGCAAGAAAAATGGACACCGAGTCCCACA 3' 8658

L STOP

SEQ ID NO: 64 rHPIV3 WT 15325 5' ATGATGAATTGATATCGATTAAACATAAATACAATGAAGA 3' 15366

SEQ ID NO: 65 rHPIV3 LB 15325 5' ATAAATGAATTGATATTGATTAAATACGTACG TACAATGAAGA 3' 15366

SEQ ID NO: 66 rBPIV3 wt 15319 5' ATAAATGAATTGATATTGATTAAATACATAAAAAACATAAAATA 3' 15360